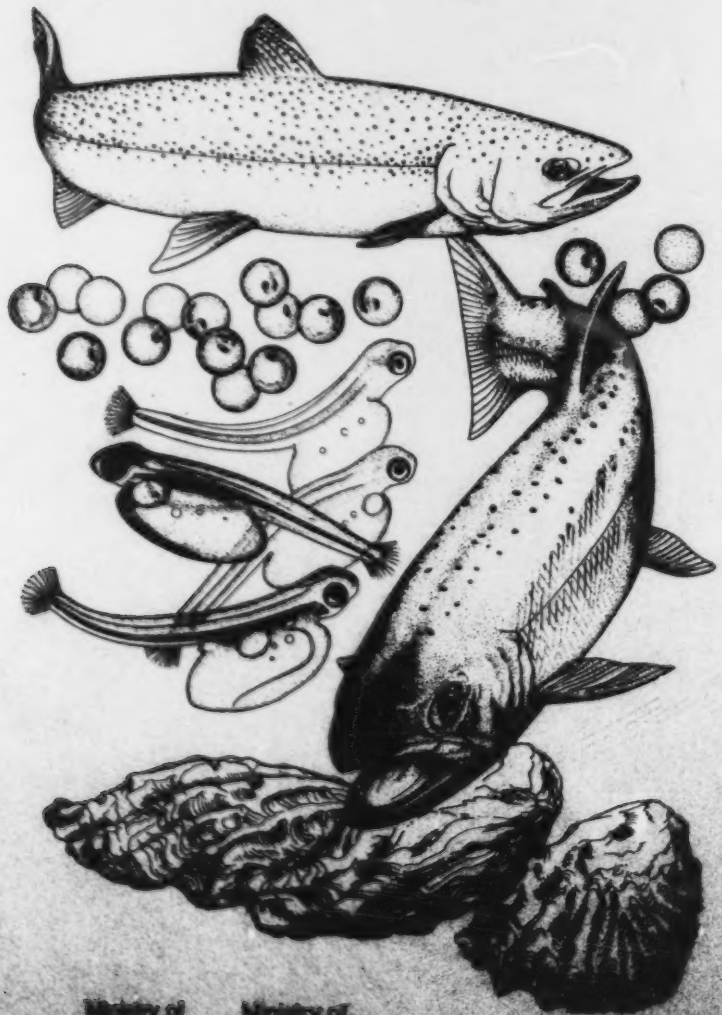
Freshwater TROUT FARMING in British Columbia



Province of British Columbia
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FRESHWATER TROUT FARMING

IN

BRITISH COLUMBIA

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I. INTRODUCTION

There is increasing interest among British Columbians in the private or commercial culture of trout. This booklet will provide a summary of provincial policy, current legislation, and some background information on freshwater trout-farming. It is intended as a starting point for the prospective farmer.

The technical information contained in this booklet provides broad guidelines so the prospective farmer is made aware of some of the problems in raising trout commercially or privately. The Ministry of Agriculture and Food or Ministry of Environment cannot be held liable for any failures even after strict adherence to these guidelines.

For more detailed information prospective growers are encouraged to read some of the material listed in the bibliography, visit at least one government hatchery, and contact the Western Trout Farmers' Association. The Association provides a variety of services, including the names of local representatives, consulting services, technical information and sources of fish stocks (a fee may be charged depending on the information you require).

II. MANAGEMENT OF TROUT FARMS

A good fish farm site must not only meet regulatory requirements but must be suitable for growing fish. The following section is intended to provide the prospective farmer with sufficient information to decide whether to apply for a permit.

Introduction

One of the first decisions to be made is what sort of operation you want: Private fish pond for your own enjoyment or commercial business. If you want to make a business of it, you must then decide which phase, or combination, of culture you want to persue:

- Food Market Sales: production, preferably fresh, is sold directly to the consumer or delivered to retail markets or restaurants;

- Supply other growers with eggs, fry, fingerlings or larger fish; and/or

- Fee Fishing: customers angle in ponds stocked with catchable-sized fish, paying by the length or weight of the fish they catch. A provincial angling licence is not required, and no sport fishing closure, limit, or gear regulations apply.

Once this decision has been made, the management of the farm follows logically, with the extent of the operation dictating the facilities required: hatchery, incubators, troughs, raceways and/or ponds.

Several other factors must be considered in order to grow trout successfully. Trout require a supply of clean, cool water with relatively high dissolved oxygen concentrations.

Fish culture facilities should be designed and located for optimum efficiency. The fish must be kept under regular supervision. They must be fed and monitored for disease. A commercial farm requires considerable commitment to succeed and a grower's lifestyle must be adapted to it.

Criteria for Trout Survival:

A. The Water

1. Source

A good supply of quality water is required for trout culture. The usual sources of fresh water include springs, wells, streams and lakes. Many of the successful trout hatcheries draw their water from springs or artesian wells. These usually have a relatively constant temperature and flow rate, low silt load and an absence of pollution and disease organisms. Springs may have low oxygen levels but this can be overcome by artificial aeration.

Waters from streams or lakes have low winter temperatures which retard fish growth and high summer temperatures which impose a variety of stresses, including low oxygen concentrations and promotion of disease outbreak and spread. In addition, surface water sources are often associated with low water flows in the summer resulting in slow growth and increased susceptibility to disease.

Fish production is constrained by the quantity and quality of water available. The flow must be sufficient to remove metabolic

wastes and maintain oxygen levels, but not so great that the fish must swim too vigourously. Flow requirements for fish depend upon a number of parameters including the oxygen content, fish size and water temperature. Assuming the water is saturated with oxygen, a 1000 kg of 10g or 100g fish reared in water at a temperature of 15° C would require approximately 2400 and 1500 l/min. respectively. This is equivalent to load rate of 0.4 and 0.7 kg/l/min. or 4.0 and 7.0 lb/gal/min., respectively.

In planning an operation it is important to consider both present and future expansion requirements to ensure your water source will supply your needs.

Fresh water should be supplied separately to each pond to prevent the possible spread of disease. However, limited re-use of water from one enclosure to another is possible through in-tank aeration or tumbling water, with splashboards, from one enclosure to another. Though costly, water can be treated for re-use with biological filters and aerators.

2. Temperature

The optimal temperature range for rapid trout growth is 10 - 18°C. Temperatures above 18°C result in poor growth, increased susceptibility to disease and reduced oxygen levels in the water. Temperatures above 20°C should be avoided and above 24°C is often lethal. Temperatures below 10°C also result in slow growth and food production in natural ponds is low. Water can be heated if the water source has a low temperature, but this will of course increase the cost of production.

3. Dissolved Oxygen

Trout require well-aerated water with an oxygen concentration of at least 5-6 mg/l measured at the outlet. As temperature increases, the water's ability to hold oxygen decreases while the requirements of the fish increase due to higher metabolic rates. Therefore, in order to maintain good growth and survival during the summer, it may be necessary to reduce fish densities, increase flushing rates or artificially aerate the water. Careful planning of facility design is important in the prevention of low oxygen concentrations in both summer and winter. Removing organic materials from the bottom (decaying organic matter consumes oxygen), ensuring adequate depths, and

providing wind exposure encourages higher oxygen concentrations. Other aeration methods, including spraying water onto the water surface, circulating with water pumps or compressed air, or removing ice and snow in winter, may be prohibitively expensive.

4. Other Water Quality Parameters

Neither the Ministry of Agriculture and Food nor the Ministry of Environment carry out water quality sampling. Inexpensive testing kits may be obtained from scientific supply companies, or you may wish to hire a consultant to do the tests for you. If time permits, the least expensive test is to place a few fish into the water for some time (preferably one growing cycle) and see how well they survive and grow.

Table I lists the optimum levels of important parameters of water quality for trout culture.

Table I: Water Quality Standards for Trout Culture

Dissolved oxygen	min. 5 milligrams per litre (mg/L)
pH	6.7 - 9.0
Alkalinity	20 - 200 mg/L (as $CaCo_3$)
Carbon dioxide	max. 2 mg/L
Calcium	min. 52 mg/L
Zinc	max. 0.04 mg/L at pH 7.6
Copper	max. 0.006 mg/L in soft water
	max. 0.3 mg/L in hard water
Iron	max. 1.0 mg/L
Ammonia-nitrogen	max. 0.012 mg/L as NH_3
Nitrite-nitrogen	max. 0.55 mg/L
Nitrogen	max. 110% of total saturation
Suspended solids	max. 80 mg/L
Dissolved solids	max. 400 mg/L
Hydrogen sulfide	max. 0.002 mg/L

(Source: Klontz et. al. 1979)

Any detectable concentrations of the following may reduce water quality sufficiently to render it unsuitable for rearing trout:

residual chlorine
phenolics
cyanide
sulfide
surfactants
pesticides
oils

B. The Fish

1. Species of trout for Farming

At present the only species of trout licensed province-wide for culture is rainbow. They have a high market demand and are most suitable for culture because they have been selectively bred for many generations for certain desirable characteristics such as faster growth rates, early maturity, disease resistance, docility and tolerance to crowding.

There are no local fish farms which supply brook trout or kokanee, and it may be difficult to obtain stocks from outside of B.C. which are certified disease-free.

Other species may be licensed in different Fisheries Regions in B.C. - for example, carp is allowed in the Fraser Valley. Anyone considering culturing fish other than rainbow trout should contact their Regional Office of the Ministry of Environment regarding licensing.

2. Sources of Fish

Fish cannot be taken from public waters to supply a fish farm, nor do Provincial Hatcheries supply fish for private use. Fish must be supplied from a commercial fish farm. Most farmers buy fry or fingerlings from established B.C. trout farmers. Some of the more productive growers raise their trout to maturity and maintain their own brood stocks for production of eggs. References providing information for maintaining brood stocks and incubating eggs can be found in the bibliography.

3. Growth

Under normal feeding and fish density conditions, growth is primarily dependent on water temperature. A growth formula has been devised (Iwama and Tautz 1981) which, when modified slightly, can be used to predict expected weights of trout after a specific time period when the water temperature is known. It is also possible to determine whether heating or cooling the water is necessary to produce a certain sized fish within a specific time interval. It should be noted that these values will vary with the degree of domesticity of trout since wild strains grow more slowly than domestic strains. Table II shows approximate expected growth of domestic rainbow trout fry at different temperatures over a one-year period. Typical growth of domestic rainbow trout at varying temperatures over the course of one year is illustrated in Table II.

Table II: Calculating Approximate Weight by Time and by Temperature for Trout Fry with an Initial Weight of 0.2 g.

	Expected weight in grams at various times			
Temperature (C^{o})	3 months (t = 90)	6 months (t = 180)	9 months (t = 270)	12 months (t = 360)
10	4.7	20.8	56.2	118.4
11	5.6	26.0	71.7	152.4
12	6.7	32.22	89.8	192.5
13	7.9	39.2	110.7	239.0
14	9.3	47.2	134.7	292.5
15	10.8	56.2	161.9	353.4
16	12.5	66.2	192.5	422.2
17	14.3	77.4	226.8	499.4
18	16.3	89.8	264.9	585.5

4. Stocking Rates

Rearing density is influenced by a number of factors, including water quality and flow rate. It is also largely influenced by fish size.

In an earthen pond with a depth of 2 m or more and with little or no water inflow, stocking rates sould be restricted so that standing crop does not exceed 6 kg/m^3. In a tank or raceway with flowing water standing crop should not exceed 30 kg/m^3.

Where water quality is questionable or where the grower is inexperienced, initial tests should be conducted at half the stocking rates prescribed above.

To determine stocking rates, then, much will depend on the ultimate size of the fish you intend to produce, e.g. fingerling, yearling or larger, and your ability to control mortality.

5. Disease

The commercial culturist's greatest asset is the fish - a living organism - and particular care must be taken to protect that asset. Fish are subject to many forms of disease, infection and parasitism, and are particularly susceptible in the crowded, unnatural conditions of an artificial fish pond. Abnormal appearance or behavior, or unexplained mortality, may be the result of a number of factors, including disease caused by viruses, bacteria, fungi or parasites. The first indication of a problem requires prompt action to avert the loss of an entire stock of fish. Every grower should own a good reference book on trout health/disease. Several are listed in the bibliography.

Fish under stress are most susceptible to disease outbreak and rapid spread. Preventive measures to reduce stress are extremely important: these include a good supply of clean, well-aerated water, control of stock densities and minimal handling of the fish. Some other disease control measures are:

i) <u>cleanliness</u> - all fish holding facilities and equipment should be cleaned regularly, since disease-causing bacteria multiply quickly in dirty conditions. Ease of cleaning, then, is an important consideration in facility design;

ii) <u>diet</u> - every effort should be made to ensure that trout are receiving a reasonably balanced and nutritious diet. Inexpensive fish foods may save money initially, but improperly fed fish have a much lower resistance to disease;

iii) <u>prophlactic treatment</u> - routine treatment will do much to minimize outbreaks of disease. Various chemicals, when used at regular intervals and in proper concentrations, aid in disease prevention. Immunization of the fish may in some cases increase their resistance to certain diseases. Medicinally

treated food is available on the market, as are a variety of specific vaccines and antibiotics which are often effective in controlling disease.

Isolation and disinfection of a diseased trough or pond is essential.

6. Food

The efficient culture of trout is affected by the quality and quantity of food available. Trout raised in artificial facilities will require additional food as the amount naturally available in the water supply will be insufficient. A number of artificial diets have been developed and considerable research has been done to determine the amount of food required, growth rates under artificial conditions, methods of presenting the food, and the most economical yet nutritious foods to use.

Two types of food are commonly used - wet and dry. Dry food is generally cheaper and easier to use, handle and store. However, there is less wastage of the moist pellet, as it seems to be more readily accepted by the fish, particularly by the smaller ones.

Feed tables are available from feed manufacturers which show the amount of food required per kilogram of fish at specific water temperatures to produce the most economical, but not necessarily the largest, fish. These charts should be used as a rough guide for feeding schedules. The conversion of trout food to trout flesh is generally excellent. Trout farmers might expect a (wet) weight gain of 1 kg for each 1 1/2 to 2 kg of (dry) food supplied.

The supplier of your eggs or fingerlings, or the local agricultural feed supplier, may be able to advise you regarding sources of trout food.

7. Mortality

Mortality can range anywhere from zero to 100 percent. Death can result from a number of causes, many of which are associated with facility maintenance and water quality. Oxygen depletion may result from decomposition of excessive amounts of dead plant and animal material, uneaten food and fish feces. Even living plants which produce oxygen during the day consume it during the

night and on dark, cloudy days. Increased temperatures reduce the water's carrying capacity for oxygen while increasing metabolic rates and therefore the oxygen requirement of the fish, which further stresses them. While only extreme temperatures directly cause death, the stress resulting from water temperatures that are higher than optimal leaves the fish susceptible to disease and parasitism. Susceptibility is also increased by over-crowded conditions, inadequate nutrition and any handling of the fish.

The introduction of toxic materials into trout-rearing waters is another cause of death. Pesticides often contain chemicals toxic to fish, even in small concentrations. Metabolic wastes, if allowed to accumulate, may also be toxic.

Methods to reduce the incidence of mortality include the following:

1. periodically remove excess vegetation
2. aerate the water, if necessary
3. increase pond depth and/or incoming water flow to maintain optimal temperatures.
4. clean facilities periodically, including disinfecting all equipment
5. provide prophylactic drug treatments to fish stocks
6. provide a nutritious diet
7. control stocking densities of ponds/troughs/raceways
8. minimize handling
9. use caution in using pesticides in the vicinity of rearing facilities or water sources
10. ensure water flow is sufficient to remove metabolic wastes

C. The Rearing Facilities

Several types of rearing facilities are available to the trout farmer depending on the type of operation.

1. Hatcheries

For the culturist wishing to hatch and rear trout from the egg stage there are several commercial egg incubators available. Once the eggs hatch they are normally transferred to fry-rearing troughs. A relatively low flow of water is necessary to incubate eggs and rear the fry to a size large enough for transfer to ponds or raceways. However, a large number of small fish requires a somewhat greater flow of water than does the same

weight of large fish. Water may be heated to accelerate egg development and growth of young fish.

2. Rearing Ponds

To raise fish to yearling size or larger, rearing ponds are used. These can vary from long, narrow raceways to round pools, and are usually constructed of cement, metal, fibreglass, or wood, and may be plastic-lined. Most artificial ponds are easily cleaned and disinfected for the control of disease, and it is relatively easy to capture the fish from them. The flow of water should be enough to replace the water once or twice in an hour.

Earthen ponds are used successfully in many commercial operations. Earthen ponds require less capital outlay than other artificial structures, but they are somewhat more difficult to clean and disinfect, making disease control more difficult.

a. Pond Design

The diversity in pond design precludes a lengthy discussion here. However, several factors common to all systems should be considered. While this section refers chiefly to earthen ponds, much is also applicable to other artificial rearing facilities.

i) Location

The location of a pond is affected by alternative uses, size, source of water and wind exposure.

ii) Source of Water

An adequate supply of water to keep the pond full throughout the year is essential. Wells provide a good source of water but they may be expensive to drill or may not supply a sufficient quantity of water.

iii) Depth

A very deep pond is not essential for trout culture. One to two meters in a flowing system, or two to four meters in a static one, may be adequate.

iv) Size

This is an individual's choice and will depend on the location of the pond and scope of the operation.

v) Wind Exposure

In static ponds, good wind exposure is important. Wind helps circulate the water in the pond, replacing areas of low oxygen concentration with oxygen-rich water.

The movement of water deters the formation of algal mats on the surface, and even in winter good wind exposure will aid in trout survival by blowing off snow, hindering ice formation and thereby retarding subsequent oxygen depletion.

vi) Filter

Where a trout pond drains into a natural waterway, some form of screen or filter is required to prevent the escape of fish to the wild. If surface water is used as a water source, a screen is also necessary at the intake to prevent wild stocks from entering the facility.

b. Pollution

Many pesticides are lethal to trout. Furthermore, they may accumulate in trout flesh making the fish unsafe for human consumption, and therefore not acceptable for sale. As a precaution, pesticides should not be applied near the pond or its water source.

Drainage from barnyards or feedlots may add nutrients to pond water and cause accelerated plant growth. Algal blooms may occur and increase the possibility of oxygen depletion.

c. Predators

Many animals which prey on trout are also protected by the Wildlife Act. Pond construction, then, should be planned to exclude predators as much as possible. This may involve the use of an enclosed shed or netting over the pond.

III. THE BUSINESS OF TROUT FARMING

Depending on the size and type of operation, a trout farm may be a costly venture. Before continuing with plans to construct a facility, it is essential to determine initial costs of construction and operation, and how it is to be financed. What materials are needed to construct the pond? What about engineering or other consulting fees, if you need help with design? How much does feed cost? How much will be needed? Fish - how many and at what cost? What about other expenses - e.g. electricity, labor, disease treatment. Have you made any contingency plans - e.g. what if your stocks become diseased, or there is a power failure?

Will you be able to supply 100% of the capital or will you require a loan? What types of loans are available to you as a farmer? What are your markets? How much can you expect to receive as a return on your investment?

Fish farming necessitates a certain lifestyle. The farmer must be committed to the enterprise because raising trout is time-consuming and risky. Long hours are required for the farm's routine: feeding the stock several times per day; monitoring for disease and water quality; cleaning facilities; record-keeping; business planning. An outbreak of disease or a power failure could result in the loss of an entire stock and, therefore, revenues. Furthermore, the farmer must have both technical and business competence; a lack of either should be compensated for by taking courses or hiring people who have the competence.

Considerable thought must be given to the establishment of a trout farm, since there are many factors to consider. Anyone considering raising trout, either commercially or privately, is encouraged to complete the Farm Management Plan Questionnaire (Appendix II) as an aid to planning. Commercial culturists should develop a Business Plan and prepare a cash flow projection. A Business Plan is a summary of business objectives and how resources will be organized to achieve them. The cash flow is used to set out clearly when cash from sales will be received and when cash will be needed to pay bills as they become due. These documents are important not only to provide you personnaly with a realistic perspective, but they are also used as a control to measure your success. Furthermore, these documents are required for tax purposes as well as by lending institutions or investors should you need to borrow money fo finance your operations.

The B.C. Ministry of Industry and Small Business Development has prepared an Independent Business Handbook which serves as a guide for establishing or buying a business. The Ministry also has a

number of other brochures and guidelines helpful in business planning. Prospective commercial culturists are strongly urged to obtain copies of these and use them to prepare a Business Plan and cash flow projection.

The Ministry of Industry and Small Business Development also provides free business counselling, information on government programs, and a free objective review of Business Plans. Other sources of assistance to businesses include the Chamber of Commerce Business Information Center, the Federal Business Development Bank, and the B.C. Ministry of Agriculture and Food.

IV. LEGAL ASPECTS OF FRESHWATER FISH FARMING IN BRITISH COLUMBIA

Wild trout and salmon are of major importance to the freshwater sport fishery as well as the marine sport and commercial fisheries. These fisheries annually contribute close to one billion dollars to the economy of British Columbia and therefore deserve a high degree of protection. The deliberate or accidental introduction of new fish species to B.C.'s waters could greatly decrease wild trout and salmon populations through predation or competition for food and habitat. The spread of fish diseases by transplants of infected fish could have equally devastating consequences. It is also undesirable for escaped domestic strains of trout to intermingle and breed with wild trout.

The protection and management, for public benefit, of the fisheries resources of British Columbia falls under the jurisdictions of both the Federal Department of Fisheries and Oceans and the Provincial Fisheries Branch of the Ministry of Environment. The Federal Government manages all marine fisheries and anadromous salmon in fresh water. Furthermore, it regulates all fish imports and exports (dead and alive) and all transplants of fish to natural waters. The Provincial Government manages all freshwater fisheries, except anadromous salmon, and all fresh water fish farms. The management and control of fresh water use and consumption and the disposal of domestic and industrial effluents are also under Provincial jurisdiction.

Fresh water fish farming is authorized and controlled by the issue of a number of permits and licences. These are listed below along with a brief description of their requirements.

1. Private and Commercial Fish Culture Permits

It is unlawful to possess, transport or traffic in live fish (gold-fish and tropical aquarium fish excepted) unless authorized by permit. Authorization for fish farming is provided by issue of private and commercial fish culture permits. A Private Fish Culture Permit allows holding or raising fish for personal use or as a hobby. A Commercial Fish Culture Permit allows holding or raising fish for resale.

a. **Possession** - both types of fish culture permits state which species of fish may be possessed and the location (legal description) of the property where they may be kept. Species typically permitted include:

i) domestic rainbow trout in most areas of British Columbia;
ii) common carp in the Lower Fraser Valley;
iii) anadromous salmon (hatcheries) in the areas near salt water; and
iv) Atlantic salmon (under strict health protection regulations).

Other species authorized by the Director, Fisheries Branch, may be allowed for scientific or educational purposes but only under strict and special conditions.

b. **Transport** - Fish culture permits authorize limited transport of live fish. Most commercial fish culture permits allow transport of a particular species between any two fish farms licenced for that species. Private fish culture permits, however, only allow transport in one direction: from a commercial fish farm to a private fish farm.

Rainbow trout may currently be moved quite freely between licenced fish farms throughout B.C., but these movements may be restricted in the near future to a number of zones within the Province.

The outbreak of a serious disease at a commercial farm may result in an immediate revision of the farm's permit, to prohibit transport of live fish from it.

Transport of live fish between two fish farms must be by the most direct route and, though exchange of transport water enroute is allowed, no effluent from fish tanks may be drained to public waters. Discharge may be to dry

ground, preferably gravelly, where it will seep away rather than flow on the surface to a lake or stream. Any dead fish removed in transit must be buried under at least 0.3 m (1 foot) of ground.

c) **Trafficking** - A commercial fish culture permit authorizes the purchase and sale of the fish, whereas a private fish culture permit only authorizes their purchase. This, of course, is restricted to the species stated in the permit.

d. **Fish Culture Systems Allowed** - Until recently, Ministry of Environment Policy was that private and commercial fish culture operations would only be permitted on private land. This policy is now expanded to allow fish culture activities both on private land and, in specific circumstances, on Crown (public) land or water. The Provincial Fisheries Branch manages public water primarily for recreational use while recognizing and supporting the development of viable freshwater fish farm operations. To minimize conflicts between two potentially competing uses of water for fish production, fish culture permits may only be issued where the fresh water in question is:

i) A lake or pond which is completely surrounded by private land with no public access and from which fish cannot escape, or

ii) for netpen culture only in open-system waters (waters having an inlet or outlet), or parts thereof, identified by the Regional Fish and Wildlife Manager as having minimal recreational value or potential and contributing little to wild fish production, or

iii) a self-contained hatchery, fish rearing or fish holding facility equipped with (but not limited to) incubators, artificial rearing ponds, rearing troughs, raceways or aquariums.

A good water source is necessary and for self-contained facilities may be supplied, under licence, by gravity flow or it may be pumped from lakes, streams, flowing springs or wells. Municipal water supplies of acceptable quality may also be used (e.g. beware of high chlorine content). A stream may not be dammed to create a fish pond.

The Ministry of Environment is sometimes willing to stock natural lakes and ponds at no cost to adjacent landowners provided the public is allowed free access to such waters for angling (under Provincial regulations and licence). Contact the nearest Regional Office of the Ministry of Environment for information.

e) **Permit Conditions** - In addition to the restrictions and limitations described above, fish culture permits contain certain other conditions. Both private and commercial fish culture permits require that water supply to and discharge from a fish holding facility be adequately screened or filtered to prevent the escape of live fish contained therein. Both permits also require that fish farmers provide, at their own expense, any prophylatic treatment for disease control of their fish that is prescribed by the Ministry of Environment. Commercial fish culture permits further require a farmer to maintain an up-to-date inventory of fish stocks and a record of all sales and purchases; submit an annual report to the Ministry of Environment summarizing fish sales, purchases and inventory; issue a receipt to every person to whom fish are provided; and any other condition that may from time to time be added to the permit.

f) **General** - At present, no fees are charged for private or commercial fish culture permits but this policy is under review and fees for both permits may soon be prescribed. All fish culture permits expire annually on March 31 and application for renewal must be filed prior to the expiry date.

Anyone interested in engaging in private or commercial fish farming should not proceed past the planning stage without completing and submitting a fish farm application form (Appendix V) which is available from the nearest Regional Office of the Ministry of Environment. In most cases, completion of a management plan will be required (Appendix II). The location of the facility and the proposed plan will very likely require inspection by Ministry personnel to ensure compliance with permit requirements. Only after the application is approved and a fish culture permit is issued may the applicant proceed to procure live fish.

2. Water Licence

A Water Licence is issued by the Water Management Branch of the Ministry of Environment. It is required for private or commercial fish farms if surface water is to be used. A water licence is issued for an indefinite time period and if more than one licence is held on a particular source, the licence with the earliest date will have priority on the water. Water licences are normally issued until no additional water is available for further licencing. A water licence does not guarantee supply.

Information required to obtain a water licence includes:

a) a statement of water source and point of diversion;
b) yearly operating period;
c) maximum water quantity required; and
d) water transport method to be used.

Information sheets and application forms are available from Regional Water Managers of the Ministry of Environment. The annual fee for a water licence for fish culture purposes is $20.00 but subject to change, and the water licence must be issued before a private or commercial fish culture permit is issued.

3. Waste Management Effluent Permit

An effluent permit, issued by the Waste Management Branch, Ministry of Environment, may be required if there is concern about waste material being discharged that contains feces, unused food, metabolic wastes, processing waste or residue from facility cleaning. These materials will have an effect on the quality of the receiving system, be it water or land. The permit is issued based on the information provided in the application and is subject to certain conditions. If any of these is violated, the permit may be cancelled or suspended. There is no fee for the permit but the applicant is required to advertise the application in local newspapers.

4. Business Licence

Persons wishing to start a commercial fish farm should enquire at the regional or municipal goverment in the area of the proposed operation to ensure that it conforms with the zoning regulations and to acquire any business licences required.

5. Import Permit

The Fish Health Protection Regulations enacted under the Fisheries Act, Canada, prohibit the import of live or dead cultured salmonids or the eggs of wild or cultured salmonids into Canada, or between provinces, unless authorized by an import permit (salmonids include trout, char, salmon, grayling and whitefish). Such permits can only be issued for sources of fish that have been inspected on a regular basis and declared by an approved pathologist (Fish Health Official) to be free of a number of diseases or disease agents listed in the regulations.

The intent of these regulations is to prevent the introduction of new fish diseases into Canada and the spread of fish diseases already found in Canada.

The British Columbia Fishery (General) Regulations under the Fisheries Act, Canada, also prohibit the import of a lengthy list of non-salmonid fishes. These are food and sport fishes that could seriously affect our native salmonids through predation or competition and may also be carriers for the import of new parasites and diseases. Their import can also be authorized but would only be for research or educational purposes.

Contact the Fisheries Branch in Victoria for further information or to obtain import permits.

V. EDUCATION

Malaspina College in Nanaimo, B.C., offers a range of aquaculture programs, from three week summer courses to a full two-year diploma program. They also undertake contract teaching of short courses of variable length for specific groups. For further information contact Malaspina College -Aquaculture and Fisheries Technology Program.

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APPENDIX I - FINANCIAL SCHEDULES

Schedule I Capital Costs

These costs are expended to provide assets for the operation and are depreciated/amortized over their useful life. If land must be purchased, that cost should also be considered at this time.

Initial fees:

Incorporation fees, including professional fees	$ _____	
Licence/permit fees	_____	
Total Fees		$ _____

Rearing facilities:

[1] Hatchery tank (construction)	_____	
[1] Rearing troughs/ponds (construction)		_____
[1] Sheds (construction)	_____	
Water diversion	_____	
Water pipe	_____	
Pumps	_____	
Heating units	_____	
Plumbing	_____	
Total Rearing Facilities		_____
Vehicles		_____

Equipment:

Fuel tanks	_____	
Fish Feeders	_____	
Fish transporters	_____	
Fish grader	_____	
Weigh scale	_____	
Miscellaneous	_____	
Total Equipment		_____
Total Capital Costs		$ _____

Note [1]: includes materials and labour.

APPENDIX I - FINANCIAL SCHEDULES

Schedule II Annual Expenses

These costs are expenses which must be paid each year of operation and are used to generate revenue.

Administrative Expenses:

Amortization	$	
Annual fees		
Labour - indirect		
Insurance - property		
Insurance - vehicle		
Maintenance		
Utilities		
Interest		
Total Administrative Expenses		$

Operating Expenses:

Feed, incl. transportation-in		
Fish, incl. transportation-in		
Labour - direct		
Disease control		
Fuel - transportation		
Fuel - heating		
Miscellaneous		
Total Operating Expenses		
Depreciation		
TOTAL EXPENSES		$

Schedule III Income Statement

This statement determines annual net income by offsetting total revenues with those expenses used to generate that revenue. This should be done for several years until a stable production cycle is achieved.

Total Revenues (Sales)		$
Less Expenses:		
Operating expenses	$	
Administrative expenses		
Total		
Less depreciation		
Net income before taxes		
Less income tax		
Net Income		$

APPENDIX I - FINANCIAL SCHEDULES

Schedule IV Net Cash Flow Statement

The net cash flow statement reflects cash revenues from operations with cash expenditures:

Net Income		$ _____
Add: depreciation and amortization expense	$ _____	_____
Subtract: any purchases of equipment	_____	_____
Net Cash Flow		$ _____

Example: Net cash flow for 5 years may show

	Year 1	Year 2	Year 3	Year 4	Year 5
Revenue	0	$39,390	$39,390	$39,390	$39,390
Expenses	$50,000	50,000	50,000	50,000	50,000
Net Income	(50,000)	(10,610)	(10,610)	(10,610)	(10,610)
+ non-cash exp.	15,000	15,000	15,000	15,000	15,000
- equip. purch.$(-)	-	-	-	-	(1,500)
Net Cash Flow $(-)	$(35,000)	$ 4,390	$ 4,390	$ 4,390	$ 2,890

Use Year 0 as a year of construction, thereby accounting for all capital costs but no other expenses. In the first year of operation, expenses will be incurred but no revenues generated. Thus the first year of operation will result in a net cash outflow. If you sold 6,500 kg at an average price of $6.06/kg* your revenue would be $39,390 in year 2. Assuming costs and production remain constant, your net cash inflow will be $4,390 in years 2-4. But in year 5 you find you must purchase additional miscellaneous equipment for $1,500. The resulting calculation shows a reduced net cash inflow to $2,890.

As stated, this example assumes constant production and costs. In reality, production will change over time, and expenses will change accordingly. Inflation will further increase costs, and the selling price of fish will change. All these factors will affect cash flow. This example is for illustrative purposes only, to be used as a guide in determining your own net cash flow.

* B.C. Commercial Fish Farm Statistics - 1984.
The 1984 farm gate price ($/kg) for rainbow trout food market sales ranged from $2.80 to $10.78 with an average of $6.06.

APPENDIX II

MANAGEMENT PLAN QUESTIONNAIRE FOR
COMMERCIAL FISH FARMS

Permit/Licences:

1. Are you using surface water for any phase of your operation? _____

   If so, have you applied for a Water Licence? Consider present and future requirements. _____

2. Will any effluent be discharged from your operation? _____

   If so, have you applied for a Waste Management Permit? Consider present and future requirements. _____

Economics

1. On the accompanying schedules, provide estimates of all capital costs required for constructing facilities, annual operating expenses, and cash flow statement.

2. Will you require, and can you obtain financing for capital expenditures and working capital at least until first harvest? _____

Management

1. What will be your labour requirements? Include full-time and part-time labour from start-up to harvest. _____

2. a) What facilities do you intend to utilize, e.g. hatchery, rearing facilities? _____

   b) For rearing, what sorts of structures will you use? _____
   _____

   c) Provide a diagram showing locations of all facilities.

3. What utilities are available to you? _____
   _____

4. Do you have an emergency power unit? _____

5. How will you manage water quality monitoring? _____
   _____

6. How will you control algae production/build-up? _____
   _____

7. What preventative or eradication measures will you use for disease/parasites? _____
   _____
   _____

8. How will you control predation? Poaching? _____
   _____

Marketing

1. a) What are your markets? _____

   b) What return do you expect from each? _____

   c) Will your harvest coincide with market demand? _____

2. How will you transport your harvest, i.e. to be dependable for time, quality and quantity? _____
   _____

3. a) What market promotion activities have you planned? _____
   _____

   b) How much of your budget have you allocated to advertising? _____

Physical Features and Production Site

1. Will you be able to drain your ponds/troughs/raceways easily? _____

2. Will you live on-site? If not, how will you provide for supervision and maintenance? _____
   _____

3. Is the vicinity of your facility subject to pesticide applications? If so, how will you protect your stock? _____

4. Will your facility be subject to flooding? If so, how will you mitigate damage? _____

5. [Verbatim] Can you make or take delivery of fish regardless of weather conditions? _____

6. a) What is the source of your water? _____

   b) Will it provide for future expansion requirements? _____

   c) What alternative source do you have in case of emergency? _____

7. a) What is the temperature range of your water resource? _____

   b) What is the dissolved oxygen content? _____

8. What provisions have you made for aerating the water, if necessary?
   _____
   _____

9. Has your water quality been tested? What are the results? _____
   _____

10. If using surface water, how will you prevent the inadvertent introduction of wild fish, and the escape of yours?
    _____
    _____

Feeding

1. What sized pellets are best for fry, fingerlings and larger fish?

2. a) What is your source of feed?

   b) Can they supply adequate quantities of the appropriate sizes? If not, what are your alternatives?

3. What equipment do you need to feed your fish? Describe procedure.

4. a) What are your daily feeding rates?

   b) What factors did you consider to determine these rates?

   c) How will temperature changes influence feeding rates?

5. How will you continue feeding in winter, i.e. control ice cover?

6. What procedure will you use to determine food consumption?

Harvesting

1. What method of harvesting will you use?

2. Will your facilities be conducive to harvesting? Describe.

3. Will you require special holding tanks or ponds for harvested fish to await delivery?

Processing/Transplant

1. Do you plan to process (dress and/or package) fish for resale (go to #2) or transport your fish to a processor (go to #4)?

2. Will your facilities comply with provincial food-processing regulations?

3. What facilities will you have to maintain flesh quality?

4. a) How quickly can you transport your harvest to a processor?

   b) What facilities will you have to transport live fish?

APPENDIX III - CONTACTS

PROVINCIAL GOVERNMENT

Lead Agency
Ministry of Agriculture and Food
Provincial Aquaculture Coordinator
808 Douglas Street
Victoria, B.C.
V8W 2Z7 Telephone: 387-5121

Financial Assistance
Ministry of Agriculture and Food
Agricultural Credit Branch
808 Douglas Street
Victoria, B.C.
V8W 2Z7 Telephone: 387-5121

Species Information
Ministry of Environment
Marine Resources Section
Fisheries Branch
780 Blanshard Street
Victoria, B.C.
V8W 1X5 Telephone: 387-4573

Freshwater Fish Permits (Ministry of Environment Regional Offices)

Vancouver Island Region (Nanaimo)	584-8822
Thompson-Nicola Region (Kamloops)	374-9717
Kootenay Region (Nelson)	354-6333
Cariboo Region (Williams Lake)	398-4211
Skeena Region (Smithers)	847-7303
Omineca Region (Prince George)	565-6145
Okanagan Region (Penticton)	493-8261

Aquatic Land Leases/Licences
Ministry of Lands, Parks and Housing
Policy Branch
1019 Wharf Street
Victoria, B.C.
V8W 2Y6 Telephone: 387-1067

Note: For aquatic Crown land applications, contact:

Lower Mainland Region, Burnaby	660-5500
Vancouver Island Region, Victoria	387-5011
Cariboo Region, Williams Lake	398-4250
Skeena Region, Smithers	847-7334

Water Licence
Ministry of Environment
Water Management Branch
765 Broughton Street
Victoria, B.C. V8W 1E2 Telephone: 387-5981
Also contact regional offices listed under Pollution Control Permit

PROVINCIAL GOVERNMENT

Pollution Control Permit
Ministry of Environment
Waste Management Branch
810 Blanshard Street
Victoria, B.C.
V8W 1X5 — Telephone: 387-4441

Vancouver Island Region (Nanaimo)	758-3951
Lower Mainland Region (Surrey)	584-8822
Southern Interior Region (Kamloops)	374-9717
Kootenay Region (Nelson)	354-6372
Northern Region (Prince George)	565-6432

Business Registration

Registrar of Companies
Ministry of Consumer and Corporate Affairs
940 Blanshard Street
Victoria, B.C.
V8W 3E6 — Telephone Information: 387-4471
Name Reservation: 387-5051

Sales Tax Exemption

Ministry of Finance
Consumer Taxation Branch
1106 Cook Street
Victoria, B.C.
V8W 3Z9 — Telephone: 387-5321

Ministry of Environment
Fisheries Branch
780 Blanshard Street
Victoria, B.C.
V8W 1X5 — Telephone: 387-4573

Business Counselling/Financial Assistance Programs

Ministry of Industry and Small Business Development
6th Floor, 1405 Douglas Street
Victoria, B.C.
V8W 3C1 — Telephone: General Information 383-1612

Vancouver office:
Ministry of Industry and Small Business Development
#315 - 800 Hornby Street
Vancouver, B.C.
V6Z 2C5 — Telephone:
General Information 660-3900
Programs 660-1152

PROVINCE-WIDE TOLL-FREE TELEPHONE NUMBER FOR BUSINESS INFORMATION 1-800-663-0648

OTHER

Transplant Committee
Ministry of Environment
Fisheries Branch
780 Blanshard Street
Victoria, B.C.
V8W 1X5 Telephone: 387-4573

Department of Fisheries and Oceans
Pacific Region
1090 West Pender Street
Vancouver, B.C.
V6E 2P1 Telephone: 666-0519

Associations
Western Trout Farmers' Association
c/o Sun Valley Farms
31395 Silverdale Avenue
Mission, B.C.
V2V 4H9 Telephone: 826-6471

Aquaculture Education/Resources
Malaspina College
Aquaculture and Fisheries Technology Program
900 Fifth Street
Nanaimo, B.C.
V9R 5S5 Telephone: 753-3245

B.C. Institute of Technology
Forest Resource Technology Program
3700 Willingdon Boulevard
Burnaby, B.C.
V5G 3H2 Telephone: 434-5734

OTHER

In addition to these basic contacts, the Ministry of Environment has an annual publication which lists culture and processing equipment suppliers, publications and other contacts. The publication is the **Mariculture Suppliers Catalogue.** This and other technical publications and some "how to" manuals are available from:

Ministry of Environment
Marine Resources Section
Fisheries Branch
780 Blanshard Street
Victoria, B.C.
V8V 1X5 Telephone: 387-4573

APPENDIX IV - BIBLIOGRAPHY

General

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Bardach, J.E., J.H. Ryther and W.O. McLarney, 1972. Aqualculture: the farming and husbandry of freshwater and marine organisms. Wiley Interscience, New York.

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Marriage, L.D., A.E. Borell and P.M. Scheffer. 1971. Trout ponds for recreation. U.S. Fish Wildl. Serv. Washington, D.C.

McCrimmon, H.R. 1974. Freshwater aquaculture in Canada. Fish Res. Bd. Can. Bull. No. 188.

McLarney, W. No date. The freshwater aquaculture book. Hartley and Marks.

Philips, A.M. 1970. Manual of fish culture. U.S. Fish Wildl. Serv. Washington, D.C.

Piper, R.G., I.B. McElwain, L.E. Orme, J.P. McCaron, L.G. Fowler and J.R. Leonard. 1982. Fish hatchery management, U.S. Fish Wild., Serv. Washington, D.C.

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Department of Fisheries and Oceans. 1984. Fish health protection regulations manual of compliance. Misc. Spec. Publ. 31 (Revised), Fisheries and Oceans, Ottawa.

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A great many useful articles may be found in periodicals and journals such as the following.

Periodicals

Aquaculture Digest
9434 Kearny Mesa Rd.
San Diego, Ca. 92126

Aquaculture Magazine
P.O. Box 2451
Little Rock, Ak. 72203

Canadian Aquaculture Magazine
General Delivery
Kimberly, Ont. N0C 1G0

Fish Farmer
J.W. Tidy, IPC Business Press
2656 Vista Deloro
Newport Beach, Ca. 92660

Fish Farming Industries
Sandstone Building
Mount Morris, Il. 61054

Fish Farming International
AGB Heighway Ltd.
87 Blackfriars Road
London, S.E. 1, 8HB, U.K.

Progressive Fish-Culturist
American Fisheries Society
5410 Grosvenor Lane, Suite 110
Bethesda, Maryland 20814

World Mariculture Society
Louisiana State University
Division of Continuing Education
Baton Rouge, La.

Journals

Aquaculture (Associated Scientific Publishers, Amsterdam)

Canadian Journal of Fisheries and Aquatic Science

Transactions of the American Fisheries Society

Available for study at University or Dept. Fisheries and Oceans libraries.

APPENDIX V

PROVINCE OF BRITISH COLUMBIA
Ministry of Environment

Application for a PERMIT TO possess live fish for

COMMERCIAL _____ or DOMESTIC/HOBBY _____ purposes

Applicant's Name _____ Owner _____ or Manager _____

Address _____ Postal Code _____
_____ Phone No. _____

Facility Location (legal description of property) _____
_____

Species of fish to reared/held _____

Check or fill in underlined spaces wherever applicable

A. **REARING FACILITIES**

1. Egg Incubators (No.) _____ (Total capacity) _____ eggs
2. Fish Tanks (No.) _____ (Size) _____ (Material) _____
3. Man-made ponds (No.) _____ (Size) _____
4. Natural ponds (No.) _____ (Size) _____

B. **WATER SOURCE**

1. Standing water in an excavated pond _____
2. Municipal water supply _____ or pumped supply from a well _____
3. Pumped _____ or gravity flow _____

   from a lake _____, stream _____ or flowing spring _____

   (a) Lake or stream's name _____

   (b) Water Licence Number _____ Licenced flow _____

   (c) Intake screen installed? _____

C. **WATER DISCHARGE FROM FACILITIES**

1. To municipal sewer _____ or 100% ground seepage _____
2. Drain to a lake _____ or stream _____

   (a) Lake or stream's name _____which flows into _____

   (b) Outlet screen _____, rock filter _____ and/or settling pond installed? _____

Applicants with any entry in item C 2 must also provide a sketch of the facilities on page 2 (over)

Applicant's signature _____ **Date** _____ **19**___

SKETCH OF FISH CULTURE FACILITIES

Show the relative locations of your property lines, ponds and buildings and the direction of water flow from its source to the point of discharge.

This completed application should be submitted to the nearest Regional Office of the Ministry of Environment for approval.

INSPECTION REPORT

TO BE COMPLETED BY MINISTRY OF ENVIRONMENT PERSONNEL

Inspected by _____ Date _____ 19____

Remarks _____

_____

_____

Application approved: Yes _____ No _____ Species _____

Facility located in M.U. _____

Signed _____ Date _____ 19____
(Regional Fisheries Biologist)

10/85